(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2002 (16.05.2002)

PCT

(10) International Publication Number
WO 02/39157 A1

(51) International Patent Classification[7]: G02B 6/12, 6/42

(21) International Application Number: PCT/SE01/02487

(22) International Filing Date:
8 November 2001 (08.11.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0004114-5 10 November 2000 (10.11.2000) SE

(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET LM ERICSSON (publ)** [—/—]; S-126 25 Stockholm (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **LARSSON, Jacob** [SE/SE]; Havregatan 10, S-118 59 Stockholm (SE). **PALMSKOG, Göran** [SE/SE]; Stallbacken 13, S-175 43 Järfälla (SE).

(74) Agent: **ERICSSON MICROELECTRONICS AB**; Department for Intellectual Property Rights, S-164 81 Kista-Stockholm (SE).

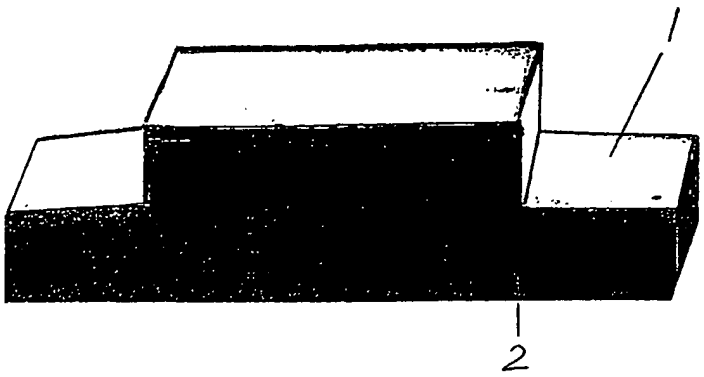
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A METHOD AND AN ARRANGEMENT FOR PASSIVE ALIGNMENT



(57) Abstract: The present invention relates to a method and to an arrangement by means of which at least one groove can be provided in a chip or in a carrier, for the alignment of a waveguide or a chip on a carrier. There can be obtained an etch profile (1) of rectangular shape by using a lithographic technique and a combination of a reactive ion etch and a wet etch on the chip (2), said etch profile being able to afford very precise alignment of a waveguide on the chip and the carrier, such as a polymeric waveguide or an optical fibre.

WO 02/39157 A1

A METHOD AND AN ARRANGEMENT FOR PASSIVE ALIGNMENT

FIELD OF INVENTION

The present invention relates to a method of providing in a chip, an alignment structure for at least one optical waveguide. The invention also relates to an alignment structure adapted for the alignment of at least one optical waveguide in accordance with the method.

DESCRIPTION OF THE BACKGROUND ART

It is known to provide chips with grooves for one or more optical waveguides wherein these grooves have also been used as tunnels for waveguides to pass through.

SUMMARY OF THE INVENTION

A novelty in this respect is that these tunnels can be made in chips of , e.g., indium phosphide as a carrier alignment structure. The concept has been to provide on the carrier, structures that can match the alignment structures in the chip, so as to enable orientation of the chip on the carrier to be determined passively. Alignment structures can be obtained very easily and with very small tolerances, by etching, such as wet etching with hydrochloric acid, such as to develop separate etch planes in a used crystal. The etched area can be defined with an own lithographic mask or with the result of an earlier process, for instance the use of an existing area of Si_3N_4 as an etching mask. The etched profile of the structures can be given, for instance, a square shape, which can afford extremely precise alignment of a waveguide, such as a polymeric waveguide or an optical fibre. It is also possible to define the orientation of a laser with this type of etch and, at the same time, produce in a chip the alignment structures for such waveguides as optical fibres. It is possible to obtain

precise agreement with respect to the orientation between alignment structure, laser, and waveguide with this latter technique. In production processes applied hitherto there has been used an alignment method which is based on the surface tension of a metal solder on the carrier onto which the chip shall be soldered. These two methods may also be combined.

These etched square alignment structures can be used as masters in replication processes. Metals can be deposited on the alignment structures and the crystal material then etched away such as to leave metal masters which can be used for structure replication. In this regard, the same alignment structure can be used to produce alignment structures on both a carrier and on the chip to be mounted on said carrier.

The invention will now be described in more detail with reference to a preferred embodiment thereof and also with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 is a cross-sectional view of a groove profile formed in a chip in accordance with the invention.

Figure 2 is a schematic perspective view of a chip that includes grooves arranged in accordance with the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figures 1 and 2 illustrate the arrangement of grooves 1 of square or rectangular cross-section arranged in a chip 2. The grooves in the detector row illustrated in Figure 1 have been formed by a combination of reactive ion etching (RIE) and wet etching. As a result of the anisotropic nature of the wet etch, different crystallographic planes are developed according to the orientation of the wet etch mask. Figure 2 shows schematically a detector row 3 which consists of four discrete detectors

4 mutually separated by 90 μm wide grooves 5. When the chip is mounted on a carrier, the grooves in the chip allow BCB-waveguides to pass through. The total imprint of the chip measures 1250 μm x 310 μm.

It will be understood that the invention is not restricted to the aforedescribed and illustrated exemplifying embodiment thereof, and that modifications can be made within the scope of the accompanying claims.

CLAIMS

1. A method of providing at least one groove in a chip or in a carrier for the alignment of a waveguide or a chip on a carrier, **characterised by** creating on the chip or on the carrier a mechanical structure that matches a waveguide or a receiving structure, by forming said mechanical structure with the aid of a lithographic technique, a reactive ion etch and/or a wet etch on the chip or carrier.

2. A method according to Claim 1, **characterised by** causing the mechanical structure to take a square shape.

3. An arrangement for the alignment of at least one waveguide or a chip on a carrier, **characterised in** that the chip (2, 3) or the carrier includes a mechanical structure (1, 5) that matches a waveguide or a receiving structure, wherein said mechanical structure is formed by a lithographic technique, a reactive ion etch and/or a wet etch on the chip or the carrier.

4. An arrangement according to Claim 3, **characterised in** that the mechanical structure has a rectangular shape. **Obs! A rectangle includes a square**

5. The use of an arrangement for aligning at least one waveguide or a chip on a carrier for replication, **characterised in** that the chip (2, 3) or the carrier includes a mechanical structure (1, 5) which matches a waveguide or a receiving structure, said mechanical structure being obtained with the aid of a lithographic technique, a reactive ion etch, and/or a wet etch on the chip or carrier, wherein the mechanical structure of the chip or the carrier is used for the replication of grooves in a plastic material, by metal plating the grooves on the chip or the carrier and etching away chip material or carrier material such as to leave a metallic structure that has a ridge pattern that enables said structure to be used to form a pattern in the plastic material.

6. The use according to Claim 5, **characterised in** that the metallic structure has a rectangular shape and can be used to form patterns in said plastic material.

1/1

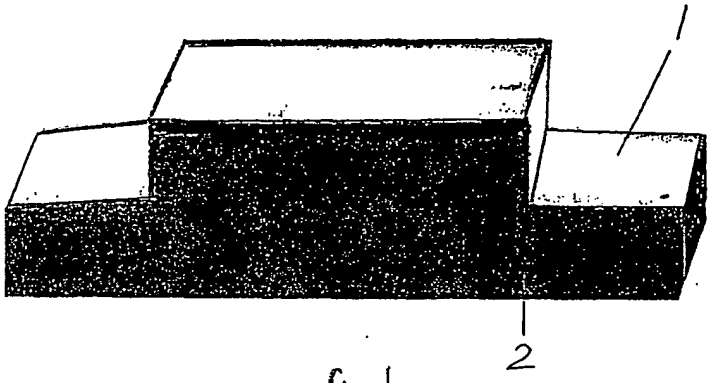


fig. 1

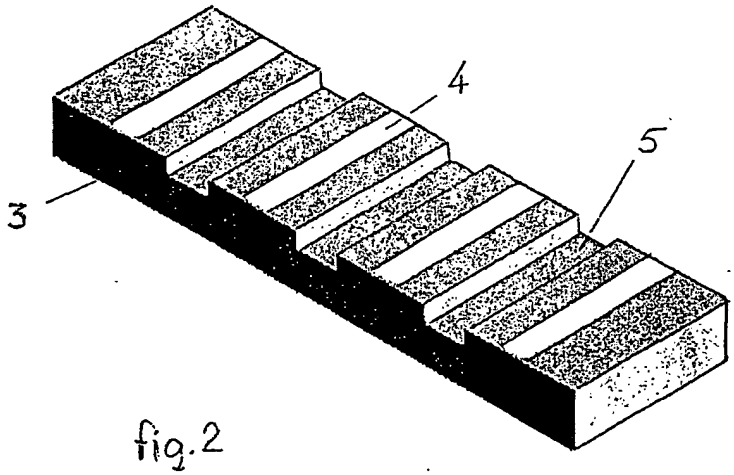


fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/02487

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G02B 6/12, G02B 6/42
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G02B, H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI-DATA, PAJ, INSPEC, EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9736201 A1 (TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)), 2 October 1997 (02.10.97), see whole document	1,3,5
Y		2,4,6
	--	
X	LARSSON et al. 'Silicon based Replication Technology of 3D-Microstructures by Conventional CD-Injection Molding Technique.' In: 1997 International Conference on Solid-State Sensors and Actuators, Transducers' 97, Chicago, June 16-19, 1997, pages 1415-1418	1-6
Y		2,4,6
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 March 2002	02 -04- 2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Stig Edhborg/MN Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 01/02487

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ERICSSON et al,'Precision passive alignment technologies for low cost array FTTH component.' In: 2000 IEEE/LEOS International Conference on Optical MEMS, 21-24 August 2000, pages 115-116. --	1-6
A	PALMSKOG et al. Low-cost single mode optical passive coupler devices with an MT-interface based on polymeric waveguides in BCB. The International Journal of Microcircuits and Electronic Packaging, Second Quarte 1998, Vol. 21, No. 2, pages 151-153, ISSN 1063-1674 --	1-6

INTERNATIONAL SEARCH REPORT

28/01/02

International application No.
PCT/SE 01/02487

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9736201 A1	02/10/97	AU 2186997 A	17/10/97
		AU 7004196 A	01/04/97
		CA 2250247 A	02/10/97
		CN 1214774 A	21/04/99
		EP 0890125 A	13/01/99
		EP 1011409 A	28/06/00
		JP 2000507367 T	13/06/00
		SE 510049 C	12/04/99
		SE 9601137 A	26/09/97
		TW 396644 B	00/00/00
		US 5984534 A	16/11/99